Oprea Sergiu-Daniel

Gr. 30322/2

Tema lab 4

Ex. 2

S - intrare $x[n]$, ieşire $y[n]$

$y[n] = x[n](g[n] + g[n-1])$

a) $g[n] = 1 \ \forall n$, show that S invariant in time

$\Rightarrow y[n] = x[n](1+1) = 2x[n]$

$$\begin{cases} y_{x\text{-shifted}}[n] = T[x_{sh}[n]] = T[x[n-n_0]] = 2x[n-n_0] \\ y_{x\text{-}sh}[n] = y[n-n_0] \ ? \qquad y[n-n_0] = 2 \cdot x[n-n_0] \end{cases}$$

$\Downarrow$

$y_{s\_sh} = y[n-n_0] \Rightarrow$ S - invariant în timp (LTI)

b) $g[n] = n \ \forall n$, show that S invariant in time

$\Rightarrow y[n] = x[n](n+n-1) = x[n](2n-1)$

$y_{x\text{-}sh}[n] = T[x_{sh}[n]] = T(x[n-n_0]) = (2n-1) \cdot x[n-n_0]$

$$\left.\begin{aligned} y_{x\text{-}sh}[n] &= x[n-n_0](2n-1) \\ y[n-n_0] &= x[n-n_0](2(n-n_0)-1) \end{aligned}\right\} \Rightarrow \text{not equal} \Rightarrow S \text{ is not LTI}$$

c) $g[n] = -1 + (-1)^n \ \forall n$, S-invariant in time

$\Rightarrow y[n] = x[n](-1+(-1)^n + 1 + (-1)^{n-1}) = x[n]((-1)^{n-1}(-1+1)-2) = -2x[n]$

$y_{x\text{-}sh}[n] = T[x_{sh}[n]] = T[x[n-n_0]] = (-2+(-1)^n + (-1)^{n-1})\, x[n-n_0]$

$y[n-n_0] = x[n-n_0](-2+(-1)^{n-n_0} + (-1)^{n-n_0-1})$

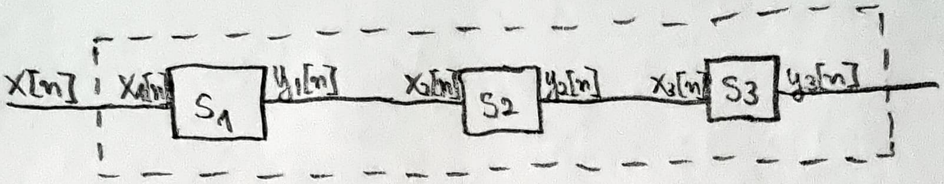
$\Rightarrow x[n-n_0] \cdot (-2) = (-2) \cdot x[n-n_0] \Rightarrow$ S - invariant in time (LTI)

3. $S_1: \ y[n] = \begin{cases} x\left[\frac{n}{2}\right], & n\text{-par} \\ 0, & n\text{-impar} \end{cases}$

$S_2: \ y[n] = x[n] + \frac{1}{2}x[n-1] + \frac{1}{4}x[n-2]$

$S_3: \ y[n] = x[2n]$

a)



$y[n] = y_3[n]$

$x_3[n] = y_2[n]$

$x_2[n] = y_1[n]$

$x_1[n] = x[n]$

$y[n] = y_3[n] = x_3[2n] =$

$= x_2[2n] + \frac{1}{2}x_2[2n-1] + \frac{1}{4}x_2[2n-2] =$

$= \underbrace{y_1[2n]}_{x_1\left[\frac{2n}{2}\right] = x[n]} + \frac{1}{2}\underbrace{y_1[2n-1]}_{0} + \frac{1}{4}\underbrace{y_1[2n-2]}_{x_1\left[\frac{2(n-1)}{2}\right] = x[n-1]}$

$\Rightarrow y[n] = x[n] + \frac{1}{4}x[n-1]$

$y_{x\_sh}[n] = T[x_{sh}[n]] = T[x[n-n_0]] = x[n-n_0] + \frac{1}{4}x[n-n_0-1]$

$y[n-n_0] = x[n-n_0] + \frac{1}{4}x[n-n_0-1]$

$\Rightarrow$ equal

$\Rightarrow$ S - time invariant

$T[K\cdot x[n]] = K\cdot x[n] + \frac{1}{4}\cdot K\cdot x[n-1]$

$K\cdot T[x[n]] = K\cdot x[n] + \frac{1}{4}\cdot K\cdot x[n-1]$

$\Big\} \Rightarrow$ homogenous (1)

$T[x_1[n] + x_2[n]] = x_1[n] + x_2[n] + \frac{1}{4}x_1[n-1] + \frac{1}{4}x_2[n-1]$

$T[x_1[n]] + T[x_2[n]] = x_1[n] + \frac{1}{4}x_1[n-1] + x_2[n] + \frac{1}{4}x_2[n-1]$

$\Big\} \Rightarrow$ additive (2)

(1), (2) $\Rightarrow$ S - linear